ELECTROSTATIC DISCHARGE-FREE CONTAINER FOR INSULATING ARTICLES

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The invention relates to the fabrication of integrated circuit devices, and more particularly, to a method and apparatus for storing and transportation of components, such as reticles, that are used in semiconductor manufacturing.

(2) Description of the Prior Art

In the art of creating semiconductor devices, it is frequently required to transport these devices from one location in the semiconductor foundry to another location. The same is true for parts of processing tools, such a reticles, which may be required at more than one location. In view of the cost of the parts that are being transported, it is to be expected that extreme care must be taken during transportation, assuring that no damage is incurred by the transported components as a result of the transportation thereof.

Components that may need to be transported include the indicated reticles but can also comprise semiconductor (ceramic, glass, gallium arsenide, sapphire and silicon) substrates,

surfaces containing epitaxial layers of silicon supported by a base semiconductor, printed circuit boards, flex circuits, metallized substrates, substrates used for flat panel displays and semiconductor device mounting support.

When transporting semiconductor components, one of the causes of concern is the occurrence of Electro Static Discharge (ESD) or static electricity, which readily develops on surfaces that contain insulating materials since the insulating materials inhibit the free flow of accumulated electrical charges to other, potentially less harmful locations. Any frictional contact or movement that occurs between components containing insulating materials is prone to result in the accumulation of electromagnetic charges. These electromagnetic charges will, at the time that these charges are brought in contact with a conductive path of low resistivity, discharge, potentially causing damage to the components on the surface of which the ESD has accumulated or injury to an individual through whom the discharge may take place.

Strict measures are typically taken to prevent the accumulation of electrical charges by methods of grounding production equipment, by controlling the humidity in the work environment thus preventing the accumulation of electrical charge

or by facilitating discharge to ground surfaces by making these surface more conductive and therefore more likely to form a conduit for ongoing electrical discharge during operational activities. As a side benefit of these activities it is typically found that other negative factors in the manufacturing environment, such as the accumulation of dust, is also further controlled and reduced.

When however taking into account the size and the complexity of a typical semiconductor manufacturing facility, in addition to the large number of processing tools that are typically present in such a facility, it is to be expected that the occurrence of the accumulation of random electrical charges as yet remains a problem and that the complete elimination of such charges is an objective that as yet has to be met.

Since however it remains a requirement that semiconductor components, as listed above, must as yet be transported from location to location within a semiconductor foundry, it is good policy to assume that randomly accumulated electrical charges are present and that therefore the components that are being transported must be protected against potential damage from these charges during transportation. For this purpose a container is

frequently used into which the component is posited during transportation.

To avoid the above highlighted problems, the container must be constructed such that no electrical charge can affect the component that is loaded into the container. Current containers consist of the body of the container that comprises a top lid, a bottom lid and four sidewalls that extend between the top lid and the bottom lid in a planar perpendicular construction. The top lid, bottom lid and sidewalls define the cavity of the container. The materials that are typically used for the creation of the elements of the container contain electrically insulating materials such as polymeric materials, for reasons that have been detailed above.

With this type of a construction it has however been found that, due to the uniform nature of the elements of the container when viewed in cross section of these elements, electrical charge may as yet accumulate on the elements of the container, charging one or more of the elements of the container and therefore as yet penetrating to the component that is contained inside the container.

It is therefore of value for the process of transporting semiconductor components in a semiconductor manufacturing environment to provide a container such that no electrical charge can penetrate to the component that is transported inside the container. The invention provides such a container by inserting a metallic coating between layers of polymeric materials, a stack of polymeric material and metallic coating is used to create the elements (such as a top lid, a bottom lid and sidewalls) of the container.

US 6,196,391 (Li) and US 5,999,397 (Chen et al.) show containers for ESD protection of reticles.

US 5,469,963 (Bonora et al.) is a related patent.

US 4,776,462 (Ksugi et al.) shows a container for a reticle.

SUMMARY OF THE INVENTION

A principle objective of the invention is to provide a container that can be used to transport semiconductor components such that these components will not be affected by discharge of static electricity.

It is another objective of the invention is to provide a method and package for handling a photolithographic reticle.

Another objective of the invention is to provide a method and package that prevents the occurrence of ESD on a photolithographic reticle.

In accordance with the objectives of the invention, a new container is provided whereby an article that is stored inside the cavity of a container will not be affected by a discharge of static electricity. The article stored in the container is protected against electromagnetic charges that accumulate as a result of the triboelectricity mechanism and charges that are induced by an electromagnetic field. A compound material is used for the creation of the container, the compound material contains a metallic material that is wedged between layers of polyimide material. The layering of materials effectively shields the component that is loaded into the container against surrounding electromagnetic fields.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a three dimensional view of the component container of the invention.

Fig. 2 shows a cross section of the component container of the invention.

Fig. 3 shows a cross section of a side surface of the component container of the invention.

Fig. 4 shows flow diagram of the steps that are required to create the component container of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The current method and materials that are used for the creation of a container that is used to transport electrical components is first reviewed.

The material that is used for the conventional creation of a container is polymethylmethacrylate (PPMA). The disadvantage that is incurred using this material is that electric charges can accumulate on the container, charging the elements of the

container and in this manner penetrating to a component that is positioned inside the container. Electric charges accumulate on inside surfaces of the container, coming in contact with the component that has been placed inside the container, exposing the component to an electromagnetic discharge (ESD).

The invention provides for creating a container using layers of material, an outer layer of PPMA is followed by a central layer of metal (such as aluminum) which is followed by an inner coating of PPMA. The construction is shown in three-dimensional view in Fig. 1 the highlights of which are as follows:

- 10, the component container of the invention
- 12, the main body of the component container 10 of the invention
- 14, the (front) access door of the component container 10 of the invention
- 16, a set of two hinges by which the front access door of the component container 10 of the invention rotate and by means of which the front access door 14 of the component container 10 of the invention is attached to the main body 12 of the component container 10 of the invention
- 18, knobs or protrusions attached to the front of the access door 14 of the component container 10 of the invention which

allows for opening the front access door 14 in a rotating motion limited by hinges 16

- 20, the lower edge or extremity of access door 14, stretching between point 20′ and 20″

- 22, the upward and rotating motion of edge 20 during the opening of access door 14

- 24, the front surface of the component container 10 of the invention

- 26, the back surface of the component container 10 of the invention

- 28, the left side surface of the component container 10 of the invention when facing the component container facing the access door 14 of the component container 10 of the invention

- 30, the right side surface of the component container 10 of the invention when facing the component container facing the access door 14 of the component container 10 of the invention

- 23, the bottom surface of the component container 10 of the invention

- 25, the top surface of the component container 10 of the invention.

Above have been listed the main elements of the container 10 of the invention. In order to be able to better define the container of the invention, it is of value to state that the

container 10 of the invention has three dimensions. These three dimensions are typically referred to as Cartesian X, Y and Z dimensions (see diagram as part of Fig. 1) that have all the properties of conventional Cartesian X, Y and Z coordinates such as intersecting under an angle of 90 degrees. These Cartesian coordinates of the container of the invention can be defined as intersecting at point 65, placing the container 10 of the invention above the X-Y plane in a Z-direction. Point 65 is the intersect between the front surface 24, the bottom surface 23 and the left side surface 28. Positive directions of the three axis along which the Cartesian coordinates are plotted are the directions that extend along the X-axis from point 65 to the right side surface 30 (the positive direction for the X coordinate), that extend along the Y-axis from point 65 to the back surface 26 (the positive direction for the Y coordinate) and that extend along the Z-axis from point 65 to the top surface 25 (the positive direction for the Z coordinate).

The thickness of the surfaces of the component container 10 of the invention, such as front surface 24 and back surface 26, has not, for reasons of simplicity, been indicated in the three dimensional view shown in Fig. 1.

Fig. 2 shows a cross section of the component container 10 of the invention, taken in a plane that is parallel with the front surface 24 and the back surface 26 of the container 10 of the invention. The exact location of the cross sectional plane is not important as long as this cross sectional plane does not intersect the front surface 24 or the back surface 26 of container 10 of the invention but is located between these two surfaces 24 and 26. Plane 2-2′ has been highlighted as one of the planes that can be used for the cross section of Fig. 1 that is shown in Fig. 2.

Specifically shown in the cross section of Fig. 2 are the following elements of the component container of the invention:

- 23, the bottom surface of the component container of the invention
- 25, the top surface of the component container 10 of the invention
- 36, the cavity of the component container 10 of the invention; the components that are transported using the component container 10 of the invention are positioned inside cavity 36
- 38, the outer layer or shell of the surfaces of the component container 10 of the invention
- 40, a metallic coating that is embedded within the surfaces of the component container 10 of the invention

- 42, the inner layer or shell of the surfaces of the component container 10 of the invention

- 44, first supports which are provided underneath a component support unit 46

- 46, a plastic component support unit over which the components that are transported using the component container 10 of the invention are positioned during transportation

- 48, second supports which are provided on the surface of plastic support unit 46, and

50, the component, preferably a reticle, that has been positioned inside the component container 10 of the invention.

Further detail relating to the component container 10 of the invention is shown in Fig. 3, which is a cross section of a side surface of the component container 10 of the invention such as the cross section that is highlighted as cross section 3-3' in Fig. 2. The cross section that is shown in Fig. 3 is not drawn to scale. In an actual construction of the component container 10 of the invention the thickness 54 of layer 40 of metallic coating, preferably containing aluminum, is considerably less than the thicknesses 52 and 56 of respectively layers 42 and 38.

The preferred method for the construction of the component container 10 of the invention is highlighted in the flow diagram of Fig. 4, as follows:

1. start with a first container or box that is created using PPMA, this first container (having an outer surface) forms the inner shell 42 of the component container 10 of the invention, this first container is therefore provided with a (front) access door 14; step 62, Fig. 4; it is assumed that the cavity of the first container has been provided with support surfaces such as supports 44 and 48 and surface 46 that are required to position a component, such as a reticle, inside the cavity of the second container;
2. provide a metallic surface, preferably containing aluminum, and coat both surfaces of this metallic surface with a layer of polyester; step 64, Fig. 4
3. cover the outer surface of the first container with the polyester coated layer of metallic material, including the access door 14, creating a first container of PPMA that is surrounded by a (polyester covered) metallic layer; step 66, Fig. 4
4. provide a second container or box that is created using PPMA, this second container (having an inner and an outer surface) forms the outer shell 38 of the component container 10 of the

invention, this second container is therefore provided with a (front) access door 14; step 68, Fig. 4, and

5. insert the first container (surrounded by the polyester covered metallic layer) inside the second container of PPMA; step 70, Fig. 4.

Although the invention has been described and illustrated with reference to specific illustrative embodiments thereof, it is not intended that the invention be limited to those illustrative embodiments. Those skilled in the art will recognize that variations and modifications can be made without departing from the spirit of the invention. It is therefore intended to include within the invention all such variations and modifications which fall within the scope of the appended claims and equivalents thereof.